Efficacy of Hydrogen Peroxide and Formalin to Control Saprolegniasis on Lake Trout (*Salvelinus namaycush*) Eggs

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Abstract

Increasing concerns over user safety and environmental discharge following formalin use at fish culture facilities are causing fish culturists to consider alternative drugs, such as hydrogen peroxide to control saprolegniasis on fish eggs. We compared the efficacy of hydrogen peroxide versus formalin treatments to control fungal infections on lake trout eggs (*Salvelinus namaycush*) incubated in vertical flow egg incubators according to standard hatchery procedures. There were three replicate incubators for each chemical and each incubation tray contained approximately 25,000 to 30,000 eggs. Formalin (1,667 mg/L) or hydrogen peroxide (1,000 mg/L) treatments were applied once daily for 15 minutes up to the development of visible eye spots in the eggs. Eyed eggs and dead eggs were then separated using a photoelectric egg sorter and the number of each egg type was determined by volume. Both chemical treatments were effective in the control of fungus on eggs. However, mean percent of eyed eggs in an incubator treated with formalin (75%) was significantly greater ($P<0.05$) than one treated with hydrogen peroxide (70%).

Introduction

Lake trout (*Salvelinus namaycush*) are an important sport fish and are cultured in large numbers at state and federal hatcheries. Formalin is currently used to control mortality associated with saprolegniasis on lake trout eggs. However, increasing concerns over user safety and environmental discharge following formalin use at hatcheries are causing fish culturists to consider alternative drugs, like hydrogen peroxide (Low Regulatory Priority Drug), to control fungal infections on fish. For example, Iron River National Fish Hatchery has been required to lower their formalin effluent by 63%. Other state and Federal hatcheries are facing the same restrictions. Hatchery personnel would prefer to use hydrogen peroxide (breakdown products are water and oxygen) in their hatchery production facilities, however, little information is available on the safety and efficacy of hydrogen peroxide to control fungal infections on lake trout eggs under actual hatchery production conditions.

Objectives

- Compare the efficacy of hydrogen peroxide to formalin to control fungal infections on lake trout eggs in an actual hatchery production setting.
- Evaluate the safety of hydrogen peroxide and formalin to four strains of lake trout eggs.

Methods

Test Chemicals

- Hydrogen peroxide (Perox-aid, 35% active ingredient) was obtained from Eka Chemicals Inc., Marietta, GA. All test concentrations were based on active ingredient. Hydrogen peroxide treatment concentrations were verified analytically within 2 h of treatment by a potassium permanganate titration method.
- Formalin was obtained from Natchez Animal Supply, Natchez, MS. The chemical was 37% formaldehyde gas by weight dissolved in water with 10-15% methanol added to retard polymerization. All treatment calculations were based on formalin concentration (1 g formalin solution = 1 g of test solution). Formalin concentration was verified using a spectrophotometric method.

Test Eggs

- Eggs were obtained from cultured Lake Superior or Lake Michigan brood stock. The strains tested were Superior Apostle Island (SAW; year class 1995 and 1997), Superior Traverse Island (STW; year class 1995 and 1997), Superior Isle Royal (SIW; year class 1994), and Michigan Green Lake (GLW; year class 1992).

Test System

- Each chemical was tested in three double stack Heath incubators and each tray contained approximately 25,000 to 30,000 eggs (2 million eggs treated). Eggs of similar strains and spawning dates were positioned in similar locations in either the hydrogen peroxide or formalin treatment incubators. There were three to nine replicates of each strain. Each incubator was supplied with a water flow of approximately 19 L/min.

Chemical Treatments

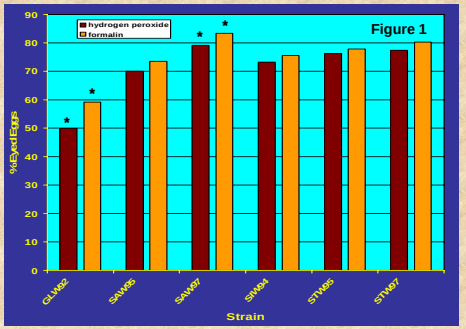
- Eggs received either 1,667 mg/L formalin or 1,000 mg/L hydrogen peroxide once daily for 15-min until eggs reached the eyed stage. No controls were tested; review of historical data revealed that most untreated eggs became infected with fungus and died. Each egg group received approximately 35 treatments. When eggs reached the eyed egg stage, live eggs and dead eggs were then separated using a photoelectric egg sorter and the number of each egg type was determined by volume.

Statistical Analysis

The probability of survival was modeled using the mixed-effects logistic model. Adjusted least-square means (Tukeys-Kramer adjustment) were used to evaluate differences among the treatment levels. Treatment levels were judged statistically different if $P \leq 0.05$.

Results

- The combined survival (as mean percent eyed eggs) of all four strains treated with hydrogen peroxide (70%) was significantly less than the eggs treated with formalin(75%; $P < 0.01$).
- Percent eyed eggs for individual strains tested was not significantly different ($P > 0.05$) between hydrogen peroxide or formalin treatments for SAW 95, STW 95, STW 97, and SIW 94, however, percent eyed eggs was significantly different ($P < 0.05$) between hydrogen peroxide or formalin treatments for SAW 97 and GLW 92 (Figure 1).



Conclusions

- Hydrogen peroxide was not as effective as formalin in producing eyed lake trout eggs. However, the overall percent of eyed eggs in an incubator varied by only 5% between the formalin and hydrogen peroxide treatments and eggs of one strain accounted for much of the difference in the percent of eyed eggs between the two chemicals.
- Hydrogen peroxide treatment is a viable option for the control of fungus on lake trout eggs, especially considering its environmental friendly breakdown products of water and oxygen. In species requiring lengthy incubation periods at cold water temperatures, higher hydrogen peroxide concentration may be required than the 500 mg/L concentration currently allowed under the Low Regulatory Priority status of hydrogen peroxide.

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